

ACI MANUAL OF CONCRETE PRACTICE—2009

The *ACI Manual of Concrete Practice* is a six-part compilation of current ACI standards and committee reports.

Part 1—ACI 117-06 to ACI 224.3R-95(08)

Part 2—ACI 225-99(05) to ACI 315-99

Part 3—ACI 318-08 to ACI 347.2R-05

Part 4—ACI 349-06 to ACI 360R-06

Part 5—ACI 362.1R-97(02) to ACI 503.7-07

Part 6—ACI 506R-05 to ACI ITG-5.1-07

Some of the most important work of the Institute is performed by its technical committees that prepare the committee reports and standards contained in the *Manual*. Technical committees of the Institute are organized into the following five groups with regard to their function: 100—General, 200—Materials and Properties of Concrete, 300—Design and Construction, 400—Concrete Reinforcement and Structural Analysis, and 500—Specialized Applications and Repair. Committees are assigned numbers that indicate their group or general area of responsibility.

Each standard of the Institute bears a hyphenated number to identify it. The first three digits identify the committee originating the standard, and the last two digits identify the year it was adopted. Thus, standard ACI 305.1-06 was prepared by Committee 305 and was adopted as a standard in the year 2006.

Committee reports are also identified by a hyphenated number with the addition of an “R” to indicate a report rather than a standard. For committee reports, the last two digits refer to either the year of original publication or, in a few cases, to the year of adoption of a related standard.

The following list contains the numbers and titles of all committee reports and standards found in the *2009 ACI Manual of Concrete Practice*. Reports and Standards are listed numerically and the location in the *Manual* follows the title.

100—General

- 117-06 Specifications for Tolerances for Concrete Construction and Materials and Commentary, **Part 1**
121R-08 Guide for Concrete Construction Quality Systems in Conformance with ISO 9001, **Part 1**
122R-02 Guide to Thermal Properties of Concrete and Masonry Systems, **Part 1**
126.3R-99 **Reapproved 2008** Guide to Recommended Format for Concrete in Materials Property Database, **Part 1**

200—Materials and Properties of Concrete

- 201.1R-08 Guide for Conducting a Visual Inspection of Concrete in Service, **Part 1**
201.2R-08 Guide to Durable Concrete, **Part 1**
207.1R-05 Guide to Mass Concrete, **Part 1**
207.2R-07 Report on Thermal and Volume Change Effects on Cracking of Mass Concrete, **Part 1**
207.3R-94 **Reapproved 2008** Practices for Evaluation of Concrete in Existing Massive Structures for Service Conditions, **Part 1**
207.4R-05 Cooling and Insulating Systems for Mass Concrete, **Part 1**
207.5R-99 Roller-Compacted Mass Concrete, **Part 1**
209R-92 **Reapproved 2008** Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures, **Part 1**
209.1R-05 Report on Factors Affecting Shrinkage and Creep of Hardened Concrete, **Part 1**
209.2R-08 Guide for Modeling and Calculating Shrinkage and Creep in Hardened Concrete, **Part 1**
210R-93 **Reapproved 2008** Erosion of Concrete in Hydraulic Structures, **Part 1**

- 211.1-91 **Reapproved 2002** Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete, **Part 1**
- 211.2-98 **Reapproved 2004** Standard Practice for Selecting Proportions for Structural Lightweight Concrete, **Part 1**
- 211.3R-02 Guide for Selecting Proportions for No-Slump Concrete, **Part 1**
- 211.4R-93 **Reapproved 1998** Guide for Selecting Proportions for High-Strength Concrete with Portland Cement and Fly Ash, **Part 1**
- 211.5R-01 Guide for Submittal of Concrete Proportions, **Part 1**
- 212.3R-04 Chemical Admixtures for Concrete, **Part 1**
- 212.4R-04 Guide for the Use of High-Range Water-Reducing Admixtures (Superplasticizers) in Concrete, **Part 1**
- 213R-03 Guide for Structural Lightweight-Aggregate Concrete, **Part 1**
- 214R-02 Evaluation of Strength Test Results of Concrete, **Part 1**
- 214.4R-03 Guide for Obtaining Cores and Interpreting Compressive Strength Results, **Part 1**
- 216.1-07 Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies, **Part 1**
- 221R-96 **Reapproved 2001** Guide for Use of Normal Weight and Heavyweight Aggregates in Concrete, **Part 1**
- 221.1R-98 **Reapproved 2008** Report on Alkali-Aggregate Reactivity, **Part 1**
- 222R-01 Protection of Metals in Concrete Against Corrosion, **Part 1**
- 222.2R-01 Corrosion of Prestressing Steels, **Part 1**
- 222.3R-03 Design and Construction Practices to Mitigate Corrosion of Reinforcement in Concrete Structures, **Part 1**
- 223-98 Standard Practice for the Use of Shrinkage-Compensating Concrete, **Part 1**
- 224R-01 **Reapproved 2008** Control of Cracking in Concrete Structures, **Part 1**
- 224.1R-07 Causes, Evaluation, and Repair of Cracks in Concrete Structures, **Part 1**
- 224.2R-92 **Reapproved 2004** Cracking of Concrete Members in Direct Tension, **Part 1**
- 224.3R-95 **Reapproved 2008** Joints in Concrete Construction, **Part 1**
- 225R-99 **Reapproved 2005** Guide to the Selection and Use of Hydraulic Cements, **Part 2**
- 228.1R-03 In-Place Methods to Estimate Concrete Strength, **Part 2**
- 228.2R-98 **Reapproved 2004** Nondestructive Test Methods for Evaluation of Concrete in Structures, **Part 2**
- 229R-99 **Reapproved 2005** Controlled Low-Strength Materials, **Part 2**
- 230.1R-90 **Reapproved 1997** Report on Soil Cement, **Part 2**
- 232.1R-00 **Reapproved 2006** Use of Raw or Processed Natural Pozzolans in Concrete, **Part 2**
- 232.2R-03 Use of Fly Ash in Concrete, **Part 2**
- 233R-03 Slag Cement in Concrete and Mortar, **Part 2**
- 234R-06 Guide for the Use of Silica Fume in Concrete, **Part 2**
- 237R-07 Self-Consolidating Concrete, **Part 2**
- 238.1R-08 Report on Measurements of Workability and Rheology of Fresh Concrete, **Part 2**

300—Design and Construction

- 301-05 Specifications for Structural Concrete, **Part 2**
- SP-15(05) Field Reference Manual (**Synopsis only**), **Part 2**
- 302.1R-04 Guide for Concrete Floor and Slab Construction, **Part 2**
- 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials, **Part 2**
- 303R-04 Guide to Cast-in-Place Architectural Concrete Practice, **Part 2**
- 303.1-97 Standard Specification for Cast-In-Place Architectural Concrete, **Part 2**
- 304R-00 Guide for Measuring, Mixing, Transporting, and Placing Concrete, **Part 2**

- 304.1R-92** **Reapproved 2005** Guide for the Use of Preplaced Aggregate Concrete for Structural and Mass Concrete Applications, **Part 2**
- 304.2R-96** **Reapproved 2008** Placing Concrete by Pumping Methods, **Part 2**
- 304.3R-96** **Reapproved 2004** Heavyweight Concrete: Measuring, Mixing, Transporting, and Placing, **Part 2**
- 304.6R-91** **Reapproved 1997** Guide for the Use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment, **Part 2**
- 305R-99** Hot Weather Concreting, **Part 2**
- 305.1-06** Specification for Hot Weather Concreting, **Part 2**
- 306R-88** **Reapproved 2002** Cold Weather Concreting, **Part 2**
- 306.1-90** **Reapproved 2002** Standard Specification for Cold Weather Concreting, **Part 2**
- 307-08** Code Requirements for Reinforced Concrete Chimneys (ACI 307-08) and Commentary, **Part 2**
- 308R-01** **Reapproved 2008** Guide to Curing Concrete, **Part 2**
- 308.1-98** Standard Specification for Curing Concrete, **Part 2**
- 309R-05** Guide for Consolidation of Concrete, **Part 2**
- 309.1R-08** Report on Behavior of Fresh Concrete During Vibration, **Part 2**
- 309.2R-98** **Reapproved 2005** Identification and Control of Visible Effects of Consolidation on Formed Concrete Surfaces, **Part 2**
- 309.5R-00** **Reapproved 2006** Compaction of Roller-Compacted Concrete, **Part 2**
- 311.1R-07** ACI Manual of Concrete Inspection—SP-2(07) (**Synopsis only**), **Part 2**
- 311.4R-05** Guide for Concrete Inspection, **Part 2**
- 311.5-04** Guide for Concrete Plant Inspection and Testing of Ready-Mixed Concrete, **Part 2**
- 313-97** Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, **Part 2**
- 313R-97** Commentary on Standard Practice for Design and Construction of Concrete Silos and Stacking Tubes for Storing Granular Materials, **Part 2**
- 315-99** Details and Detailing of Concrete Reinforcement, **Part 2**
- SP-66(04)** ACI Detailing Manual (**Synopsis only**), **Part 2**
- 318-08** Building Code Requirements for Structural Concrete (ACI 318-08) and Commentary, **Part 3**
- SP-71(08)** ASTM Standards in ACI 318 (**Synopsis only**), **Part 3**
- 325.10R-95** **Reapproved 2001** Report on Roller-Compacted Concrete Pavements, **Part 3**
- 325.11R-01** Accelerated Techniques for Concrete Paving, **Part 3**
- 325.12R-02** Guide for Design of Jointed Concrete Pavements for Streets and Local Roads, **Part 3**
- 325.13R-06** Concrete Overlays for Pavement Rehabilitation, **Part 3**
- 330R-08** Guide for the Design and Construction of Concrete Parking Lots, **Part 3**
- 330.1-03** Specification for Unreinforced Concrete Parking Lots, **Part 3**
- 332-08** Code Requirements for Residential Concrete and Commentary, **Part 3**
- 332.1R-06** Guide to Residential Concrete Construction, **Part 3**
- 334.1R-92** **Reapproved 2002** Concrete Shell Structures Practice and Commentary, **Part 3**
- 334.3R-05** Construction of Concrete Shells Using Inflated Forms, **Part 3**
- 336.1-01** Specification for the Construction of Drilled Piers, **Part 3**
- 336.2R-88** **Reapproved 2002** Suggested Analysis and Design Procedures for Combined Footings and Mats, **Part 3**
- 336.3R-93** **Reapproved 2006** Design and Construction of Drilled Piers, **Part 3**
- 341.2R-97** **Reapproved 2003** Seismic Analysis and Design of Concrete Bridge Systems, **Part 3**
- 341.3R-07** Seismic Evaluation and Retrofit Techniques for Concrete Bridges, **Part 3**
- 343R-95** **Reapproved 2004** Analysis and Design of Reinforced Concrete Bridge Structures, **Part 3**
- 345R-91** **Reapproved 2005** Guide for Concrete Highway Bridge Deck Construction, **Part 3**

345.1R-06	Guide for Maintenance of Concrete Bridge Members, Part 3
345.2R-98	Reapproved 2005 Guide for Widening Highway Bridges, Part 3
346-01	Specification for Cast-in-Place Concrete Pipe, Part 3
347-04	Guide to Formwork for Concrete, Part 3
347.2R-05	Guide for Shoring/Reshoring of Concrete Multistory Buildings, Part 3
SP-4	Formwork for Concrete (Synopsis only), Part 3
349-06	Code Requirements for Nuclear Safety-Related Concrete Structures (ACI 349-06) and Commentary, Part 4
349.1R-07	Reinforced Concrete Design for Thermal Effects on Nuclear Power Plant Structures, Part 4
349.2R-07	Guide to the Concrete Capacity Design (CCD) Method—Embedment Design Examples, Part 4
349.3R-02	Evaluation of Existing Nuclear Safety-Related Concrete Structures, Part 4
350-06	Code Requirements for Environmental Engineering Concrete Structures and Commentary, Part 4
350.1-01/ 350.1R-01	Tightness Testing of Environmental Engineering Concrete Structures (ACI 350.1-01) and Commentary (ACI 350.1R-01), Part 4
350.2R-04	Concrete Structures for Containment of Hazardous Materials, Part 4
350.3-06	Seismic Design of Liquid-Containing Concrete Structures and Commentary, Part 4
350.4R-04	Design Considerations for Environmental Engineering Concrete Structures, Part 4
351.1R-99	Reapproved 2008 Grouting between Foundations and Bases for Support of Equipment and Machinery, Part 4
351.2R-94	Reapproved 1999 Foundations for Static Equipment, Part 4
351.3R-04	Foundations for Dynamic Equipment, Part 4
352R-02	Recommendations for Design of Beam-Column Connections in Monolithic Reinforced Concrete Structures, Part 4
352.1R-89	Reapproved 2004 Recommendations for Design of Slab-Column Connections in Monolithic Reinforced Concrete Structures, Part 4
355.2-07	Qualification of Post-Installed Mechanical Anchors in Concrete (ACI 355.2-07) and Commentary, Part 4
357R-84	Reapproved 1997 Guide for the Design and Construction of Fixed Offshore Concrete Structures, Part 4
357.2R-88	Reapproved 1997 Report on Barge-Like Concrete Structures (Abstract only), Part 4
358.1R-92	Analysis and Design of Reinforced and Prestressed Concrete Guideway Structures, Part 4
359-07	Code for Concrete Containments (Synopsis only), Part 4
360R-06	Design of Slabs-on-Ground, Part 4
362.1R-97	Reapproved 2002 Guide for the Design of Durable Parking Structures, Part 5
362.2R-00	Reapproved 2005 Guide for Structural Maintenance of Parking Structures, Part 5
363R-92	Reapproved 1997 Report on High-Strength Concrete, Part 5
363.2R-98	Guide to Quality Control and Testing of High-Strength Concrete, Part 5
364.1R-07	Guide for Evaluation of Concrete Structures before Rehabilitation, Part 5
365.1R-00	Service-Life Prediction, Part 5
371R-08	Guide for the Analysis, Design, and Construction of Elevated Concrete and Composite Steel-Concrete Water Storage Tanks, Part 5
372R-03	Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, Part 5
373R-97	Design and Construction of Circular Prestressed Concrete Structures with Circumferential Tendons, Part 5
374.1-05	Acceptance Criteria for Moment Frames Based on Structural Testing and Commentary, Part 5

400—Concrete Reinforcement and Structural Analysis

- 408R-03 Bond and Development of Straight Reinforcing Bars in Tension, **Part 5**
- 408.2R-92 **Reapproved 2005** Bond under Cyclic Loads (**Abstract only**), **Part 5**
- 408.3-01/
408.3R-01 Splice and Development Length of High Relative Rib Area Reinforcing Bars in Tension (ACI 408.3-01) and Commentary, **Part 5**
- 421.1R-08 Guide to Shear Reinforcement for Slabs, **Part 5**
- 421.2R-07 Seismic Design of Punching Shear Reinforcement in Flat Plates, **Part 5**
- 423.3R-05 Recommendations for Concrete Members Prestressed with Unbonded Tendons, **Part 5**
- 423.4R-98 Corrosion and Repair of Unbonded Single Strand Tendons, **Part 5**
- 423.6-01/
423.6R-01 Specification for Unbonded Single-Strand Tendons (ACI 423.6-01) and Commentary, **Part 5**
- 423.7-07 Specification for Unbonded Single-Strand Tendon Materials and Commentary, **Part 5**
- 435R-95 **Reapproved 2000** Control of Deflection in Concrete Structures, **Part 5**
- 435.8R-85 **Reapproved 1997** Observed Deflections of Reinforced Concrete Slab Systems, and Causes of Large Deflections (**Synopsis only**), **Part 5**
- 437R-03 Strength Evaluation of Existing Concrete Buildings, **Part 5**
- 437.1R-07 Load Tests of Concrete Structures: Methods, Magnitude, Protocols, and Acceptance Criteria, **Part 5**
- 439.3R-07 Types of Mechanical Splices for Reinforcing Bars, **Part 5**
- 440R-07 Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures, **Part 5**
- 440.1R-06 Guide for the Design and Construction of Structural Concrete Reinforced with FRP Bars, **Part 5**
- 440.2R-08 Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, **Part 5**
- 440.3R-04 Guide Test Methods for Fiber-Reinforced Polymers (FRPs) for Reinforcing or Strengthening Concrete Structures, **Part 5**
- 440.4R-04 Prestressing Concrete Structures with FRP Tendons, **Part 5**
- 440.5-08 Specification for Construction with Fiber-Reinforced Polymer Reinforcing Bars, **Part 5**
- 440.6-08 Specification for Carbon and Glass Fiber-Reinforced Polymer Bar Materials for Concrete Reinforcement, **Part 5**
- 441R-96 High-Strength Concrete Columns, **Part 5**
- 445R-99 Recent Approaches to Shear Design of Structural Concrete, **Part 5**
- 446.1R-91 **Reapproved 1999** Fracture Mechanics of Concrete: Concepts, Models and Determination of Material Properties (**Abstract only**), **Part 5**
- 446.3R-97 Finite Element Analysis of Fracture in Concrete Structures, **Part 5**
- 446.4R-04 Report on Dynamic Fracture of Concrete, **Part 5**

500—Specialized Applications and Repair

- 503R-93 **Reapproved 2008** Use of Epoxy Compounds with Concrete, **Part 5**
- 503.1-92 **Reapproved 2003** Standard Specification for Bonding Hardened Concrete, Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive, **Part 5**
- 503.2-92 **Reapproved 2003** Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive, **Part 5**
- 503.3-92 **Reapproved 2003** Standard Specification for Producing a Skid-Resistant Surface on Concrete by the Use of a Multi-Component Epoxy System, **Part 5**
- 503.4-92 **Reapproved 2003** Standard Specification for Repairing Concrete with Epoxy Mortars, **Part 5**
- 503.5R-92 **Reapproved 2003** Guide for the Selection of Polymer Adhesives with Concrete, **Part 5**
- 503.6R-97 **Reapproved 2003** Guide for the Application of Epoxy and Latex Adhesives for Bonding Freshly Mixed and Hardened Concretes, **Part 5**

503.7-07	Specification for Crack Repair by Epoxy Injection, Part 5
506R-05	Guide to Shotcrete, Part 6
506.1R-08	Report on Fiber-Reinforced Shotcrete, Part 6
506.2-95	Specification for Shotcrete, Part 6
506.4R-94	Reapproved 2004 Guide for the Evaluation of Shotcrete, Part 6
522R-06	Pervious Concrete, Part 6
522.1-08	Specification for Pervious Concrete Pavement, Part 6
523.1R-06	Guide for Cast-in-Place Low-Density Cellular Concrete, Part 6
523.2R-96	Guide for Precast Cellular Concrete Floor, Roof, and Wall Units, Part 6
524R-08	Guide to Portland Cement-Based Plaster, Part 6
530-08/ASCE 5-08/TMS 402-08	Building Code Requirements for Masonry Structures, Part 6
530.1-08/ASCE 6-08/TMS 602-08	Specification for Masonry Structures, Part 6
530R-08/ASCE 5-08/TMS 402-08	Commentary on Building Code Requirements for Masonry Structures, Part 6
530.1R-08/ASCE 6-08/TMS 602-08	Commentary on Specification for Masonry Structures, Part 6
533R-93	Reapproved 2004 Guide for Precast Concrete Wall Panels, Part 6
533.1R-02	Design Responsibility for Architectural Precast-Concrete Projects, Part 6
543R-00	Reapproved 2005 Design, Manufacture, and Installation of Concrete Piles, Part 6
544.1R-96	Reapproved 2002 Report on Fiber Reinforced Concrete, Part 6
544.2R-89	Reapproved 1999 Measurement of Properties of Fiber Reinforced Concrete, Part 6
544.3R-08	Guide for Specifying, Proportioning, and Production of Fiber-Reinforced Concrete, Part 6
544.4R-88	Reapproved 1999 Design Considerations for Steel Fiber Reinforced Concrete, Part 6
546R-04	Concrete Repair Guide, Part 6
546.2R-98	Guide to Underwater Repair of Concrete, Part 6
546.3R-06	Guide for the Selection of Materials for the Repair of Concrete, Part 6
548.1R-97	Guide for the Use of Polymers in Concrete, Part 6
548.3R-03	Polymer-Modified Concrete, Part 6
548.4-93	Reapproved 1998 Standard Specification for Latex-Modified Concrete (LMC) Overlays, Part 6
548.5R-94	Reapproved 1998 Guide for Polymer Concrete Overlays, Part 6
548.7-04	Test Method for Load Capacity of Polymer Concrete Underground Utility Structures, Part 6
548.8-07	Specification for Type EM (Epoxy Multi-Layer) Polymer Overlay for Bridge and Parking Garage Decks, Part 6
548.9-08	Specification for Type ES (Epoxy Slurry) Polymer Overlay for Bridge and Parking Garage Decks, Part 6
549.1R-93	Reapproved 1999 Guide for the Design, Construction, and Repair of Ferrocement, Part 6
549.2R-04	Report on Thin Reinforced Cementitious Products, Part 6
550.1R-01	Emulating Cast-in-Place Detailing in Precast Concrete Structures, Part 6
551.1R-05	Tilt-Up Concrete Construction Guide, Part 6
555R-01	Removal and Reuse of Hardened Concrete, Part 6
T1.2-03/ T1.2R-03	Special Hybrid Moment Frames Composed of Discretely Jointed Precast and Post-Tensioned Concrete Members and Commentary, Part 6
ITG-3-04	Report on Bridge Decks Free of Steel Reinforcement, Part 6
ITG-4.1-07	Specification for High-Strength Concrete in Moderate to High Seismic Applications, Part 6

- ITG-4.2R-06** Materials and Quality Considerations for High-Strength Concrete in Moderate to High Seismic Applications, **Part 6**
- ITG-4.3R-07** Report on Structural Design and Detailing for High-Strength Concrete in Moderate to High Seismic Applications, **Part 6**
- ITG-5.1-07** Acceptance Criteria for Special Unbonded Post-Tensioned Precast Structural Walls Based on Validation Testing and Commentary, **Part 6**